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TECHNICAL MEMORANDUM (NASA) 52

INTERACTIVE LORAN-C TO GEOGRAPHIC AND GEOGRAPHIC-TO-LORAN-C COMPUTATION

An implementation of Naval Oceanographic Office computer software for LORAN-C is presented.

by

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August 1977

Supported by

National Aeronautics and Space Administration
Langley Research Center
Langley Field, Virginia
Grant NGR 36-009-017

(NASA-CR-153985) INTERACTIVE LORAN-C TO GEOGRAPHIC AND GEOGRAPHIC-TO-LORAN-C COMPUTATION (Ohio Univ.) 6 p HC A02/MF A01 CSCL 17G

N77-30101

Unclas
G3/04 45725

I. INTRODUCTION

The LORAN-to-Geographic and Geographic-to-LORAN program presented here is an adaptation of computer software developed by the Naval Oceanographic Office.[1] As work progresses on low-cost LORAN-C receivers under the Joint University Program in Air Transportation Systems, a computational benchmark is needed for comparison to off-air data and for flight planning purposes.

This computer program is implemented for Ohio University's System/370 Model 158 computer system using the Conversational Monitor System (CMS) under the Virtual Machine Facility. The program is written in FORTRAN-IV.

II. PROGRAM EXECUTION

The LORAN program is stored in CMS disk files for use by Avionics Engineering Center terminal users. A CMS EXEC file named LORAN controls program operation. The user types LORAN and the program then prompts for data input and produces output on the terminal. The FORTRAN program refers to a disk file of LORAN master data giving station locations, coding delays, repetition rate and station pair identification letters. Master file data for the U.S. East and West Coast chains, the Canadian West Coast, the Gulf of Alaska and the North Pacific chains are available, and may be selected for use from the terminal.

For Geographic-to-LORAN conversion, no iterative computations are required; the program is a straightforward coordinate conversion based upon the techniques described by the Navy.[1]

For LORAN-to-Gegraphic conversion, the original Navy program required a dead-reckoned position, near the actual unknown fix, to begin computations. No iteration was performed to obtain the LORAN fix, but internal program errors occurred at execution time if the dead-reckoned fix were displaced from the actual fix by more than a few minutes of latitude or longitude. In order to enhance usefulness of the program for the terminal user, an iterative routine was added which allows a single dead-reckoned position to be entered from the master data file for each LORAN chain. All fixes are then iterated from this assumed position. The results compare exactly with the LORAN-C navigation chart, and should provide adequate benchmark data for general-aviation flight planning and data analysis.

III. PROGRAM OPERATION

The LORAN program is capable of either LORAN-to-Geographic or Geographic-to-LORAN conversion. The user is able to select conversion type as well as the LORAN chain.

LORAN-to-Geographic conversion requires the input of two station pair letters, time difference for each station pair and, if not in the master file, a dead reckoned position.

Geographic-to-LORAN conversion requires that the latitude and longitude be entered. All input is prompted by the program.

Figure 1 illustrates LORAN-to-Geographic conversion by finding the latitude and longitude of Columbus, Ohio. The user enters the chain I.D. for the East Coast and the two station pair letters and their corresponding time differences which cross at Columbus (see Figure 2). Output consists of station pair I.D. letters, chain I.D., time differences, latitude, longitude and number of iterations.

In Figure 3, Geographic-to-LORAN conversion, the latitude and longitude are entered to generate the time difference. The output consists of chain I.D., repetition rate and time difference for all station pairs in the chain.

IV. REFERENCES

[1] "LORAN-to-Geographic Conversion and Geographic-to-LORAN Conversion", Informal Report N-3-64, Naval Oceanographic Office, Washington, D.C., June 1964.

[2] LORAN-C Navigation Chart No. VLC-30-22, Edition 5, U.S. Naval Oceanographic Office, June 1967.

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CMS

.loran
EXECUTION BEGINS...
ENTER CHAIN I.D.
.us east
ENTER GL (GEOGRAPHIC TO LORAN) OR LG (LORAN TO GEOGRAPHIC): (CR) TO QUIT
.lg
ENTER 1ST STATION PAIR I.D. LETTER
.y
ENTER 2ND STATION PAIR I.D. LETTER
.z
ENTER TIME DIFFERENCE FOR PAIR Y: XXXXX.XX
.53600.00
ENTER TIME DIFFERENCE FOR PAIR Z: XXXXX.XX
.67200.00
EAST COAST USA                    RR=99300
PAIR(1)  PAIR(2)     T(1)       T(2)       LATITUDE        LONGITUDE
   Y        Z      53600.00   67200.00    39 56.176      82 59.117      3
ENTER GL (GEOGRAPHIC TO LORAN) OR LG (LORAN TO GEOGRAPHIC): (CR) TO QUIT
.gl
ENTER LATITUDE: DEGREES,MINUTES,SECONDS:  SDDDMMSS.SSS
.  400000.000
ENTER LONGITUDE: DEGREES,MINUTES,SECONDS: SDDDMMSS.SSS
.  830000.000
EAST COAST USA                    RR=99300
      LATITUDE          LONGITUDE          W           X           Y           Z
   40   0   0.0       83   0   0.0    15911.578  42114.707  53577.789  67174.438
ENTER GL (GEOGRAPHIC TO LORAN) OR LG (LORAN TO GEOGRAPHIC): (CR) TO QUIT
.
R;
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Figure 1. Example of LORAN-to-Geographic Conversion.

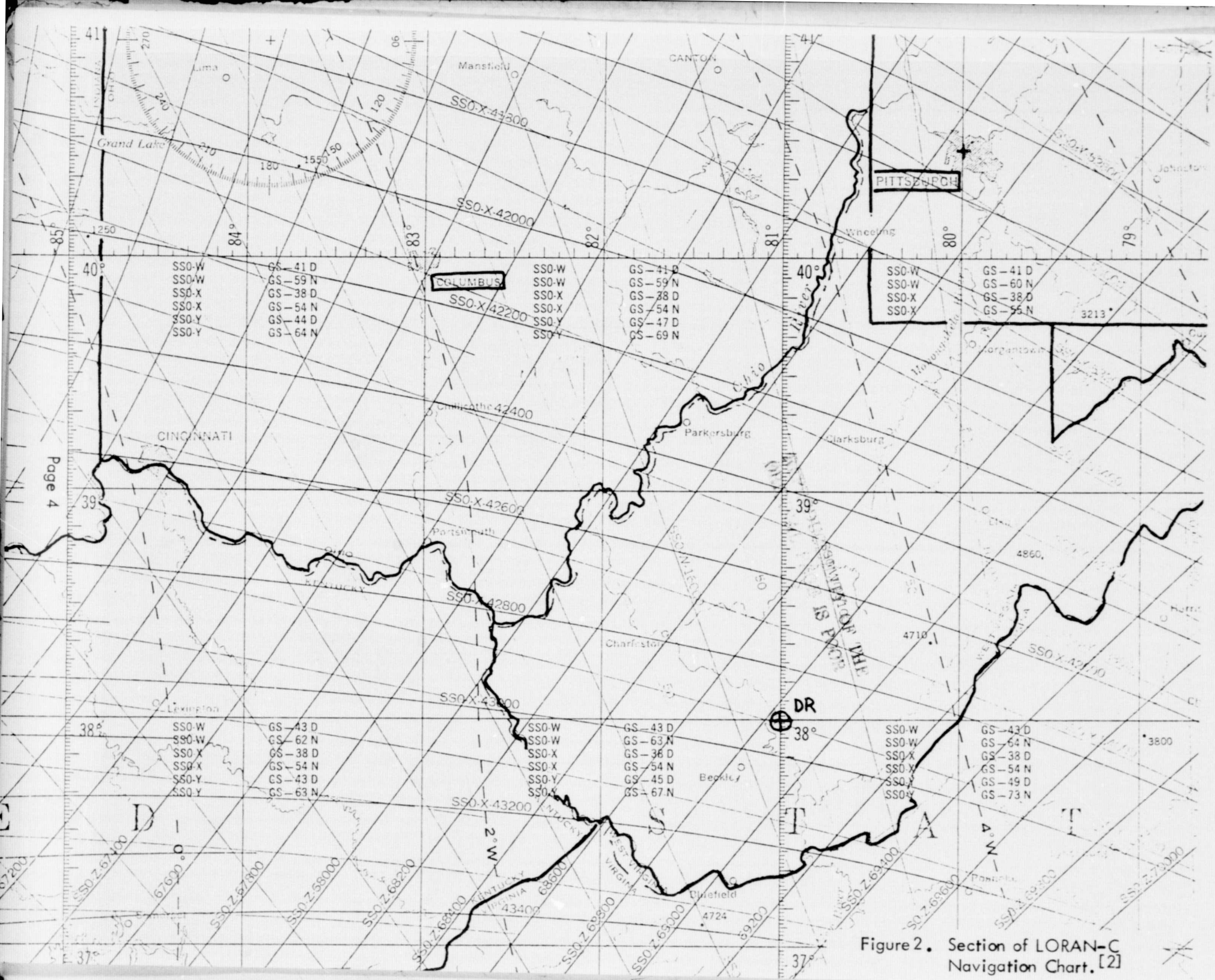

Figure 2. Section of LORAN-C Navigation Chart.[2]

```
   X         Z      41501.90 68255.38    40 27.002     79 59.999      3
ENTER GL (GEOGRAPHIC TO LORAN) OR LG (LORAN TO GEOGRAPHIC)? (CR) TO QUIT
.
R?

.


 loran
EXECUTION BEGINS...
ENTER CHAIN I.D.
.us east
>ENTER GL (GEOGRAPHIC TO LORAN) OR LG (LORAN TO GEOGRAPHIC)? (CR) TO QUIT
.gl
ENTER LATITUDE? DEGREES,MINUTES,SECONDS:  SDDDMMSS.SSS
.  402700.000
ENTER LONGITUDE? DEGREES,MINUTES,SECONDS: SDDDMMSS.SSS
.  800000.000
EAST COAST USA                  RR=99300
      LATITUDE          LONGITUDE          W           X           Y           Z
   40  27   0.0        80   0   0.0    16218.586 41501.898 52931.109 68255.375
ENTER GL (GEOGRAPHIC TO LORAN) OR LG (LORAN TO GEOGRAPHIC)? (CR) TO QUIT
.ls
ENTER 1ST STATION PAIR I.D. LETTER
.x
ENTER 2ND STATION PAIR I.D. LETTER
.z
ENTER TIME DIFFERENCE FOR PAIR X: XXXXX.XX
.41501.90
ENTER TIME DIFFERENCE FOR PAIR Z: XXXXX.XX
.68255.38
EAST COAST USA                  RR=99300
PAIR(1)  PAIR(2)     T(1)        T(2)       LATITUDE       LONGITUDE
   X         Z      41501.90 68255.38    40 27.002     79 59.999      3
ENTER GL (GEOGRAPHIC TO LORAN) OR LG (LORAN TO GEOGRAPHIC)? (CR) TO QUIT
.
R?

.
```

Figure 3. Example of Geographic-to-LORAN Conversion.

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